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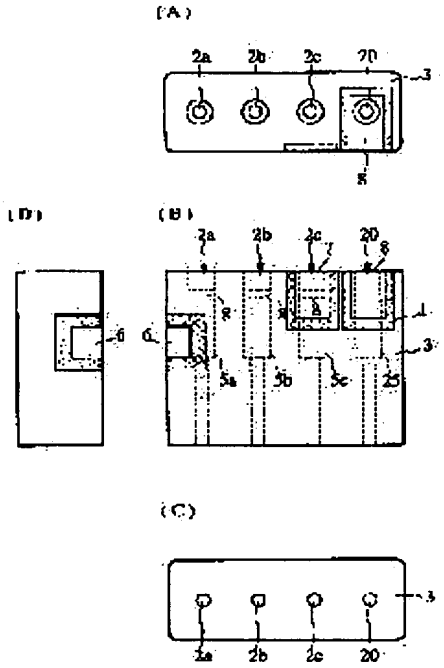
(54) DIELECTRIC FILTER AND COMPOSITE DIELECTRIC FILTER AND ANTENNA RESONATOR AND COMMUNICATION EQUIPMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a dielectric filter, composite dielectric filter, and communication equipment using them for realizing the input and output of a signal in a two terminal type or a balanced type without using any balun.

SOLUTION: Resonance lines 5a-5d are successively comb-line connected in a dielectric block 1. Outside terminals 6 and 7 to be capacitive coupled with the resonance lines 5a and 5c and an outside terminal 8 extended from one edge of the resonance line 5d are provided on the outer face of the dielectric block 1. The outside terminals 7 and 8 are capacitive coupled and inductive coupled with the resonance line 5c so that the input and output of a signal in a balanced type can be realized.



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[Date of registration]	20.09.2002
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CLAIMS

[Claim(s)]
[Claim 1] In the dielectric filter which arranged two or more resonant-line ways, and prepared two or more I/O sections combined on the predetermined resonant-line way of these resonant-line ways, respectively in a dielectric block and a dielectric plate and on the dielectric plate The dielectric filter characterized by constituting at least one of said the I/O sections from the 1st external terminal which carries out capacity coupling to a predetermined resonant-line way, and the 2nd external terminal prolonged from the end of the outer join track which combines with said predetermined resonant-line way.
[Claim 2] The dielectric filter according to claim 1 characterized by having made phase contrast of the signal of said 1st and 2nd external terminal seen from said predetermined resonant-line way 180 degrees of abbreviation, and using said 1st and 2nd external terminal as a balanced terminal.
[Claim 3] The complex-dielectrics filter characterized by having combined the resonator by said resonant-line way between the predetermined I/O section and two or more of other I/O sections among two or more I/O sections according to claim 1 or 2, and constituting two or more filters.
[Claim 4] The antenna common machine characterized by having constituted two or more I/O sections according to claim 3 from a sending-signal input terminal, an input-signal output terminal, and an antenna terminal, and constituting from a transmitting filter which prepared two or more filters according to claim 3 between said sending-signal input terminals and said antenna terminals, and a receiving filter prepared between said input-signal output terminals and said antenna terminals.
[Claim 5] The communication device characterized by forming a dielectric filter according to claim 1 or 2, a complex-dielectrics filter according to claim 3, or an antenna common machine according to claim 4 in a RF circuit part.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the dielectric filter used with a RF band, a complex-dielectrics filter, an antenna common machine, and the communication device using these.
[0002]
[Description of the Prior Art] The configuration of the dielectric filter using a dielectric block used mainly with a microwave band is shown in drawing 12 . For the front view in the condition that (B) stood the dielectric filter, and (A), in this drawing, a plan and (C) are [a left side view and (E of a bottom view and (D))] right side views. While 1 is a dielectric block and preparing 2a, 2b, and the hole for resonance tracks shown by 2c in the interior in this drawing, a conductor is prepared in those insides inside and the resonant-line ways 5a, 5b, and 5c are formed. The earth electrode 3 was formed in the external surface of the dielectric block 1, and the external terminals 6 and 7 are formed in the predetermined part from the earth electrode 3 at the insulating condition. Capacity coupling of the external terminal 6 is carried out to resonant-line way 5a, and it carries out capacity coupling of the external terminal 7 to resonant-line way 5c. Thus, the dielectric filter which has the band-pass response which consists of three steps of resonators is constituted.
[0003]
[Problem(s) to be Solved by the Invention] However, in the conventional dielectric filter as shown in drawing 12 , since it was what output and input a signal with an unbalance mold by making an earth electrode into a reference potential, respectively (for example, in order to give a signal to the amplifying circuit of a balanced input mold etc.), the external terminals 6 and 7 had to change the signal of an unbalance mold into the signal of a balanced type using the balun (unbalance-balanced converter). Consequently, the occupancy area of the filter circuit part on the circuit board increased, and it had become the cause to which this obstructs a miniaturization.
[0004] The purpose of this invention is to offer the dielectric filter which enabled it to output and input a signal with 2 terminal molds or a balanced type, a complex-dielectrics filter, and the communication device using them, without using the above-mentioned balun.
[0005]
[Means for Solving the Problem] In the dielectric filter which prepared two or more I/O sections which this invention arranges two or more resonant-line ways in a dielectric block and a dielectric plate and on a dielectric plate, and are combined with the predetermined resonant-line way of these resonant-line ways, respectively At least one of said the I/O sections consists of the 1st external terminal which carries out capacity coupling to a predetermined resonant-line way, and the 2nd external terminal prolonged from the end of other resonant-line ways which combine with said predetermined resonant-line way. The dielectric filter which outputs and inputs using two terminals which are not in phase according to this structure is obtained.
[0006] I/O of a balanced type is attained by making phase contrast of the signal of the 1st and 2nd external terminal into about 180 degrees especially.
[0007] Moreover, the complex-dielectrics filter which has two or more filters is constituted by combining the resonator by said resonant-line way between the predetermined I/O section and two or more of other I/O sections among two or more above-mentioned I/O sections. Since according to this structure two or more filters are constituted and it moreover is not necessary to prepare a balun separately in a single dielectric block and a single dielectric plate and on a single dielectric plate, the whole equipment will be miniaturized more. For example, as two or more I/O sections, a sending-signal input terminal, an input-signal output

terminal, and an antenna terminal are prepared, a transmitting filter is prepared between a sending-signal input terminal and an antenna terminal, a receiving filter is prepared between an input-signal output terminal and an antenna terminal, and an antenna common machine is constituted.
[0008] Moreover, this invention prepares the above-mentioned dielectric filter or a complex-dielectrics filter in a RF circuit part, and constitutes a communication device. Thereby, a small lightweight communication device is obtained.
[0009]
[Embodiment of the Invention] The configuration of the dielectric filter concerning the 1st operation gestalt of this invention is explained with reference to drawing 1 and drawing 2 . Drawing 1 is the projection drawing of a dielectric filter, and, for (A), a plan and (B) are [a bottom view and (D of a front view and (C))] left side views. However, the transverse plane in this drawing is a component side to the circuit board.

[0010] To the rectangular parallelepiped-like block [dielectric] 1, this dielectric filter forms the hole and electrode of a predetermined configuration, and changes. That is, 2a, 2b, and 2c are the holes for resonance tracks, and form the resonant-line ways 5a, 5b, and 5c in the inside, respectively. 20 is a hole for outer join tracks, and forms the outer join track 25 in the inside. The holes 2a-2c for resonance tracks and the hole 20 for outer join tracks are step holes with which the Johan section in drawing differs in a bore from the bottom half section, respectively. The electrode agenesis section shown by g is prepared near the edge of a side with the large bore of a step hole, and this part is used as the open end on each resonant-line way. forming in the external surface of the dielectric block 1 the external terminal 8 of the outer join track 25 which continues from an edge on the other hand, and the external terminals 6 and 7 which form electrostatic capacity among the resonant-line ways 5a and 5c, respectively, a part for these external terminal areas is removed -- the earth electrode 3 is mostly formed in the whole surface (sixth page).
[0011] By this configuration, the resonant-line ways 5a, 5b, and 5c carry out COM line association one by one first, and the external terminals 6 and 7 carry out capacitive association (henceforth "C association") to the resonant-line ways 5a and 5c, respectively. On the other hand, the outer join track 25 carries out COM line association with resonant-line way 5c, and the output of a signal is performed by inductive association (henceforth "L association") from the external terminal 8. The outer join track 25 does not act as a resonator which determines the band-pass response of a filter, but is used as a track for outer joins. Therefore, this dielectric filter acts as a filter circuit which carried out sequential association of three steps of resonators.
[0012] Drawing 2 is the representative circuit schematic of the dielectric filter shown in drawing 1 . Z1ea and Z1eb are the impedances of resonant-line way 5a here. Thus, on an equal circuit, on the two tracks, the hole for resonance tracks is a step hole, and one resonant-line way is expressed, because an impedance changes with the bores. The impedance of resonant-line way 5b, Z3ea, and Z3eb of Z2ea and Z2eb are the impedances of resonant-line way 5c similarly. Furthermore, Z4ea and Z4eb are the impedances of the outer join track 25. Cs1, Cs2, and Cs3 are electrostatic capacity produced into the electrode agenesis section g part of the resonant-line ways 5a, 5b, and 5c. Moreover, Cs4 is electrostatic capacity produced between the external terminal 8 and an earth electrode 3. Zk12o The characteristic impedance in the od mode in which COM line association between the resonant-line ways 5a and 5b is performed, and Zk12e, similarly it is the characteristic impedance in even mode. Zk23o The characteristic impedance in the od mode between the resonant-line ways 5b and 5c, and Zk23e It is Zk34o to the characteristic impedance in the even mode, and this appearance. The characteristic impedance in the od mode between resonant-line way 5c and the outer join track 25, and Zk34e It is the characteristic impedance in the even mode. For Cfi, the electrostatic capacity between the external terminal 6 and an earth electrode 3 and Cei are [the electrostatic capacity between the external terminal 7 and an earth electrode 3 and Cex of the electrostatic capacity between the external terminal 6 and resonant-line way 5a and Cfo] the electrostatic capacity between the external terminal 7 and resonant-line way 5c.
[0013] The part shown by A in drawing 2 constitutes an unbalance-balance conversion circuit. The OUT terminal of the top in drawing is an output by L association, and a lower OUT terminal is an output by C association so that clearly from this equal circuit. Therefore, phase contrast of both output signals can be made into 180 degrees by setting up suitably the value of each component which constitutes the above-mentioned conversion circuit.
[0014] In addition, although it explained that the external terminal 6 used an unbalanced input terminal and the external terminals 7 and 8 as a balanced output terminal by ****, you may make it use an unbalance output terminal and the external terminals 7 and 8 for the external terminal 6 as a balanced input terminal conversely.

[0015] Next, the configuration of the dielectric filter concerning the 2nd operation gestalt is explained based on drawing 3 . For a plan and (B), in this drawing, a front view and (C) are [(A) / a left side view and (E of a bottom view and (D))] rear view. The tooth back in this drawing is a component side to the circuit board.
[0016] In this drawing, 21 is a dielectric plate and forms the resonant-line ways 11a, 11b, and 11c and the outer join track 16 in the top face, respectively. The gap section without an electrode is formed in the predetermined part of [11a, 11b, and 11c] these resonant-line ways as an open end. Moreover, the joint electrode 12 is formed in the top face of the dielectric plate 21. If it applies to a tooth back through a top face from the transverse plane of the dielectric plate 21, the external terminal 15 is formed. Moreover, it applies to a tooth back through a left lateral from the transverse plane of the dielectric plate 21, and the external terminal 13 is formed. Furthermore, the external terminal 14 is formed in the tooth back of the dielectric plate 21. The earth electrode 10 is formed all over the abbreviation for the external surface of the dielectric plate except near [these] an external terminal.
[0017] The resonant-line ways 11a, 11b, and 11c carry out COM line association one by one, respectively. Capacity coupling of the joint electrode 12 is carried out to resonant-line way 11a, and it carries out capacity coupling of the external terminal 14 to resonant-line way 11c. Moreover, resonant-line way 11c and the outer join track 26 carry out COM line association. Therefore, it becomes the same fundamentally with what was shown in drawing 2 as an equal circuit, and the dielectric filter using an unbalanced input terminal and the external terminals 14 and 15 as a balanced output terminal is constituted in the external terminal 13.
[0018] Drawing 4 is the projection drawing of the dielectric filter concerning the 3rd operation gestalt. This uses as the so-called TORIPU rate mold the dielectric filter of the structure shown in drawing 3 . Namely, the same resonant-line ways 11a-11c as what has two dielectric plates 21a and 21b, and was shown in one dielectric plate 21a at drawing 3 , The outer join track 26 and the joint electrode 12 are formed. To dielectric plate 21b of another side These resonant-line ways, With an outer join track and a joint electrode, the resonant-line way, outer join track, and joint electrode which have the relation of the mirror symmetry are formed, and the resonant-line way and joint electrodes of both the dielectrics plate are stuck. According to this configuration, since the perimeter of each resonant-line way is surrounded with an earth electrode 10, electromagnetic-field leak outside and electromagnetic-field association with an external circuit are lost, and the dielectric filter whose property was stable is obtained.
[0019] Next, the configuration of the dielectric filter concerning the 4th operation gestalt is explained with reference to drawing 5 and drawing 6 . This dielectric filter changes the location of the external terminal 8 of the dielectric filter shown in drawing 1 . That is, the external terminal 8 is formed in an opposite side side with Men by the side of the electrode agenesis section g of a resonant-line way. INTADIJITARU association of resonant-line way 5c and the outer join track 25 is carried out according to this structure. Other structures are the same as that of what was fundamentally shown in drawing 1 . The equal circuit of this dielectric filter comes to be shown in drawing 6 . In order that resonant-line way 5c and the outer join track 25 may carry out INTADIJITARU association, it has joined together by different approach from drawing 2 . In drawing 6 , Zk34oa, Zk34ea, Zk34ob, and Zk34eb show the characteristic impedance for an INTADIJITARU bond part of the outer join track 25 and resonant-line way 5c which were formed in the hole for outer join tracks which has a step. Thus, the dielectric filter which makes the external terminals 7 and 8 of drawing 5 a balanced output terminal is obtained.
[0020] Next, the configuration of the duplexer (antenna common machine) concerning the 5th operation gestalt is explained with reference to drawing 7 . (A) of this drawing is [a front view and (C of a plan and (B))] bottom views. However, the transverse plane in this drawing is a component side to the circuit board.
[0021] 2a, 2b, and 2c, 2d and 2e are the holes for resonance tracks, and form the resonant-line ways 5a, 5b, 5c, 5d, and 5e in those insides, respectively. 20a, 20b, and 20c are the holes for outer join tracks, and form the outer join tracks 25a, 25b, and 25c in those insides, respectively. These holes 2a-2e for resonance tracks and the holes 20a, 20b, and 20c for outer join tracks are step holes with which the Johan section in drawing differs in a bore from the bottom half section, respectively. The electrode agenesis section shown by g is prepared near the edge of a side with the large bore of a step hole, and this part is used as the open end on each resonant-line way. forming in the external surface of the dielectric block 1 the external terminals 8, 6, and 9 of the outer join tracks 25a, 25b, and 25c which continue from an edge on the other hand, respectively, and the external terminal 7 which forms electrostatic capacity between resonant-line way 5a, a part for these external terminal areas is removed -- the earth electrode 10 is mostly formed in the whole surface (sixth page).
[0022] The operation of the duplexer shown in drawing 7 is as follows. The resonant-line ways 5a, 5b, and 5c carry out COM line association one by one first, and resonant-line way 5a and the external terminal 7

carry out capacity coupling. Moreover, resonant-line way 5a and outer join track 25a carry out COM line association, and resonant-line way 5c and outer join track 25b carry out COM line association. Thereby, the external terminals 7 and 8 act as a balanced output terminal, and the external terminals 6 and 7 and the filter which has the band-pass response which consists of three steps of resonators among 8 are constituted. Moreover, outer join track 25b, the resonant-line ways 5d and 5e, and outer join track 25c carry out COM line association one by one. The filter which has the band-pass response which consists of two steps of resonators among the external terminals 6 and 9 by this is constituted. Here, using a receiving filter and the latter filter as a transmitting filter, the input terminal of a sending signal is used for the external terminal 9, and the output terminal of an input signal and the external terminal 6 are used [the former filter] for the external terminals 7 and 8 as an antenna end-connection child.

[0023] Next, the configuration of the duplexer concerning the 6th operation gestalt is explained with reference to drawing 8 . For (A), in this drawing, a plan and (B) are [a bottom view and (D of a front view and (C))] rear view. The tooth back in this drawing is a component side to the circuit board.

[0024] In this drawing, 21a and 21b are dielectric plates, and form the resonant-line ways 11a-11e and the outer join tracks 26a, 26b, and 26c in the top face of dielectric plate 21a, respectively. The gap section without an electrode is formed in the predetermined part of these resonant-line ways 11a-11e as an open end. Moreover, the external terminals 15, 13, and 16 which are missing from a tooth back from the top face of dielectric plate 21a, and are prolonged from the outer join tracks 26a, 26b, and 26c are formed, respectively. The earth electrode 10 is formed all over the abbreviation for the external surface of the dielectric plate except near [these] an external terminal. Moreover, the external terminal 14 is formed in the tooth back of dielectric plate 21a.

[0025] The operation of the duplexer shown in drawing 8 is as follows. The resonant-line ways 11a, 11b, and 11c carry out COM line association one by one first, and resonant-line way 11a and the external terminal 14 carry out capacity coupling. Moreover, resonant-line way 11a and outer join track 26a carry out COM line association, and resonant-line way 11c and outer join track 26b carry out COM line association. Thereby, the external terminals 14 and 15 act as a balanced output terminal, and the external terminals 13 and 14 and the filter which has the band-pass response which consists of three steps of resonators among 15 are constituted. Moreover, outer join track 26b, the resonant-line ways 11d and 11e, and outer join track 26c carry out COM line association one by one. The filter which has the band-pass response which consists of two steps of resonators among the external terminals 13 and 16 by this is constituted. Here, using a receiving filter and the latter filter as a transmitting filter, the input terminal of a sending signal is used for the external terminal 16, and the output terminal of an input signal and the external terminal 13 are used [the former filter] for the external terminals 14 and 15 as an antenna end-connection child.

[0026] Next, the configuration of the duplexer concerning the 7th operation gestalt is explained with reference to drawing 9 . (A) of this drawing is [a front view and (C of a plan and (B))] bottom views. Unlike the duplexer shown in drawing 7 , in this example, one side of a balanced output terminal is taken out by INTADIJITARU association. That is, the external terminal 8 is formed in the base in drawing of a dielectric block, and INTADIJITARU association of resonant-line way 5a and the outer join track 25a is carried out. moreover, the object for outer join tracks -- hole 20a is taken as the step hole which made large the bore by the side of the base in drawing of a dielectric block. Other configurations are the same as that of what was shown in drawing 7 , and abbreviation.

[0027] Next, the configuration of the dielectric filter concerning the 8th operation gestalt is explained with reference to drawing 10 . Although the electrode agenesis section was prepared in the part with the dielectric filter shown until now while constituting the resonant-line way in a dielectric block and a dielectric plate and on the dielectric plate, the open end of a resonant-line way may be prepared in the external surface of a dielectric block or a dielectric plate.

[0028] While forming hole 2for resonance tracks a which 1 is a dielectric block and is penetrated in parallel mutually, 2b, 2c, and the hole 20 for outer join tracks in drawing 10 , the conductor was formed in the inside inside and the resonant-line way is prepared. These holes 2a-2c for resonance tracks and the hole 20 for outer join tracks are straight holes with a fixed bore in a cross-section ellipse. The earth electrode 10 is formed all over the abbreviation for the base in drawing of the dielectric block 1, and four side faces. The outer join track currently formed in an inside at the hole 20 for a resonant-line way and outer join tracks currently formed in the inside of the holes 2a-2c for resonance tracks is following the earth electrode 10 on the base of the dielectric block 1 in drawing. The joint electrodes 12a, 12b, and 12c prolonged from a resonant-line way are formed in the top face in drawing of the dielectric block 1, and it is made to carry out capacity coupling of between adjoining resonant-line ways. Moreover, the external terminals 6, 7, and 8 are

formed in the side face of the front left in the top face in drawing and drawing of the dielectric block 1. Capacity coupling of the external terminals 6 and 7 is carried out to the resonant-line way formed in the holes 2a and 2c for resonance tracks. Moreover, the external terminal 8 is directly prolonged from the edge of the hole 20 for outer join tracks.

[0029] According to the structure shown in drawing 10 , the external terminals 7 and 8 as an unbalance input/output terminal are used for the external terminal 6 as a balanced input/output terminal.

[0030] In addition, it is very good in structure which establishes the hole for association of the predetermined depth in the mid-position of the hole for resonance tracks which considers as the joint gestalt between resonant-line ways, in addition adjoins, gives a difference to the resonance frequency in even mode and od mode, and is combined with it.

[0031] Next, the configuration of the communication device using the above-mentioned dielectric filter or a duplexer is explained with reference to drawing 11 . this drawing -- setting -- ANT -- for a band-pass filter, AMPa, and AMPb, an amplifying circuit, MIXa, and MIXb are [a transceiver antenna and DPX / a duplexer, BPFa, BPFb, and BPFc / an oscillator and DIV of a mixer and OSC] counting-down circuits (synthesizer), respectively. MIXa modulates the signalling frequency outputted from DIV with a modulating signal, BPFa passes only the band of transmit frequencies, and AMPa carries out power amplification of this, and transmits from ANT through DPX. BPFb passes only a received frequency band among the signals outputted from DPX, and AMPb amplifies it. MIXb mixes the signalling frequency and the input signal which are outputted from BPFc, and outputs an intermediate frequency signal IF.

[0032] The duplexer DPX part shown in drawing 11 can use the duplexer of the structure shown in drawing 7 - drawing 9 . Moreover, band-pass filter BPFa, BPFb, and BPFc are the structures shown in drawing 1 - drawing 6 , or can use the dielectric filter of the structure shown in drawing 10 . Thus, a small communication device can be constituted in the whole.

[0033]

[Effect of the Invention] According to invention concerning claim 1, the dielectric filter which outputs and inputs the signal of a mutually different phase using two terminals is obtained.

[0034] According to invention which relates to claim 2 especially, I/O of a balanced type is attained by making phase contrast of the signal of the 1st and 2nd external terminal into about 180 degrees.

[0035] Moreover, since according to invention concerning claims 3 and 4 two or more filters are constituted and it moreover is not necessary to prepare a balun separately in a single dielectric block and a single dielectric plate and on a single dielectric plate, the whole equipment can be miniaturized more.

[0036] Moreover, according to invention concerning claim 5, a smaller communication device is obtained.

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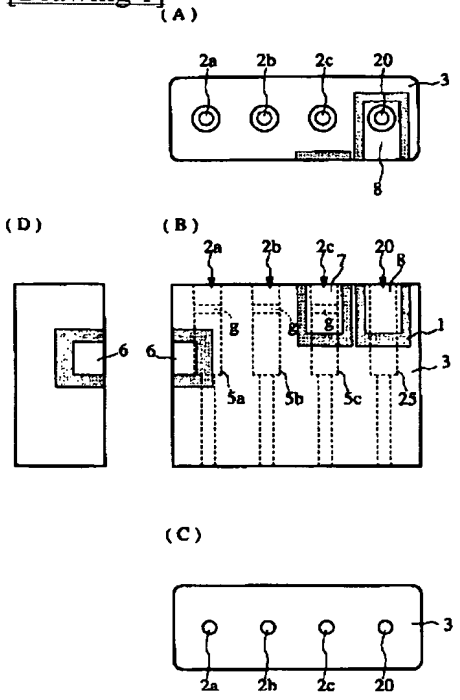
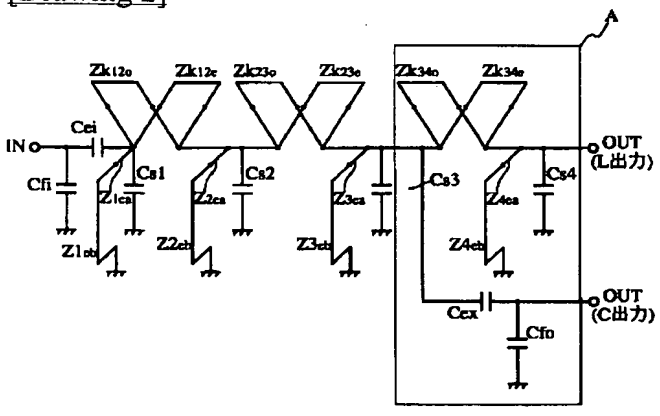
DRAWINGS

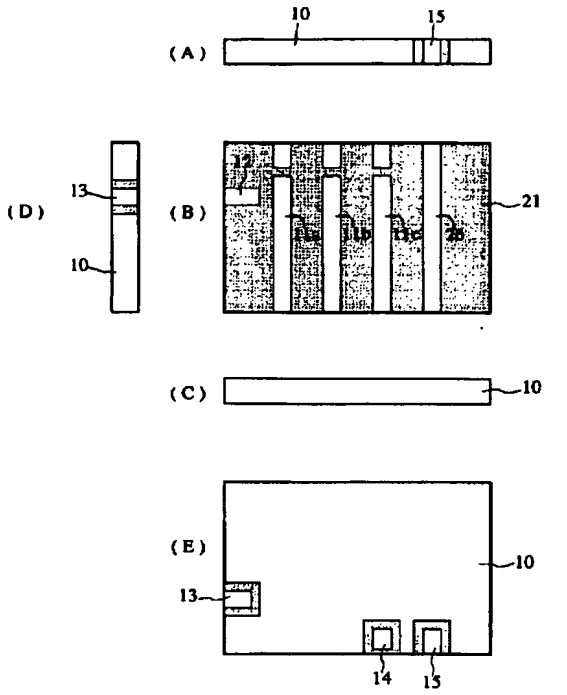
[Drawing 1]



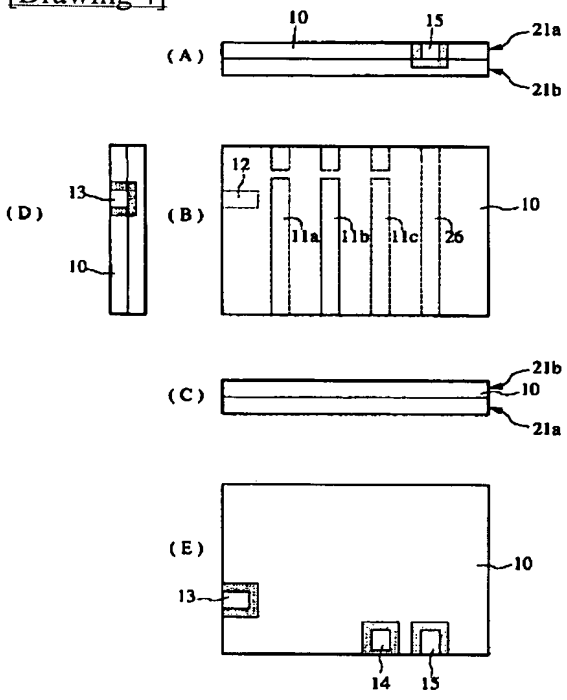
[Drawing 2]



[Drawing 3]



[Drawing 4]



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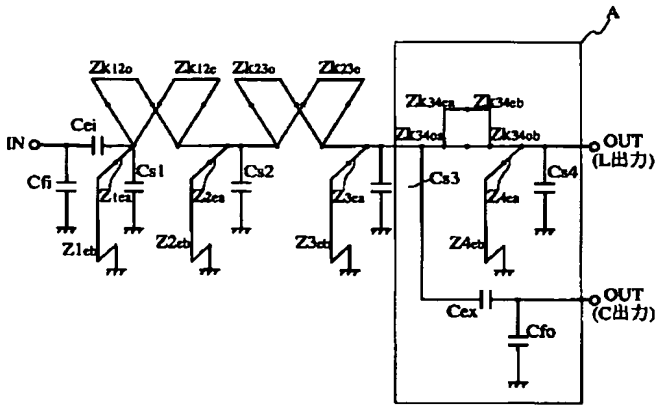
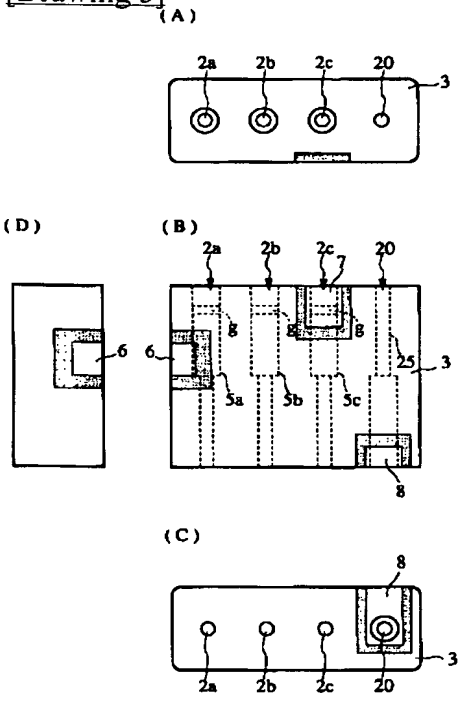
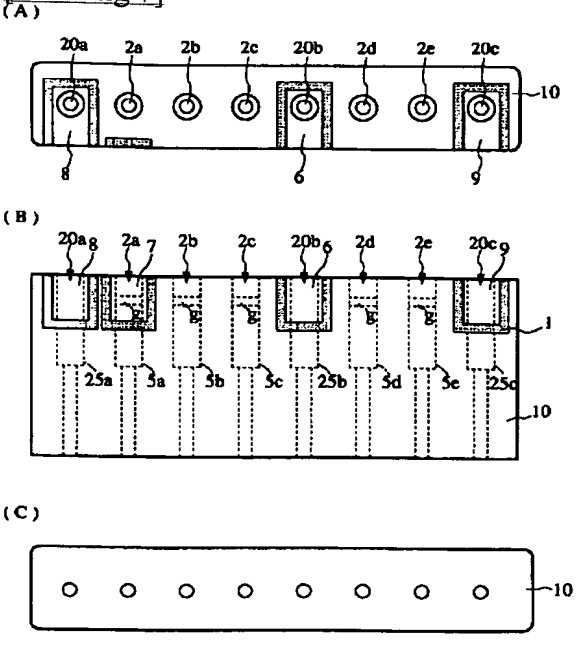


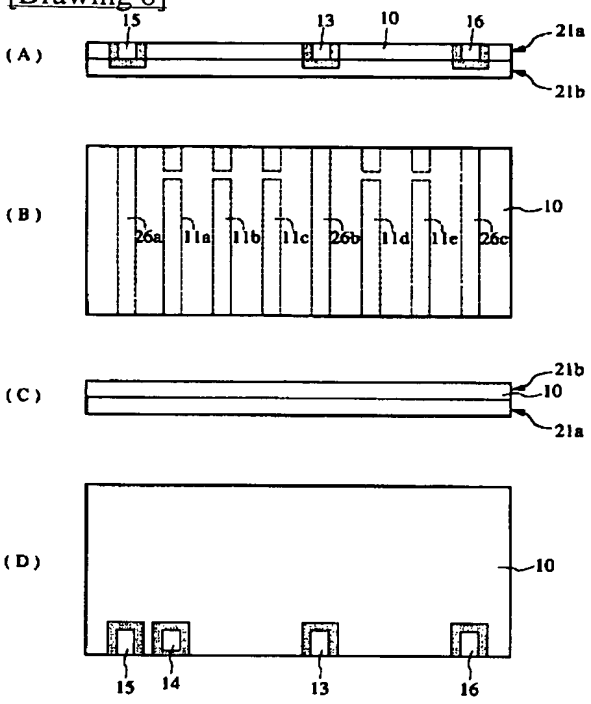
[Drawing 5]



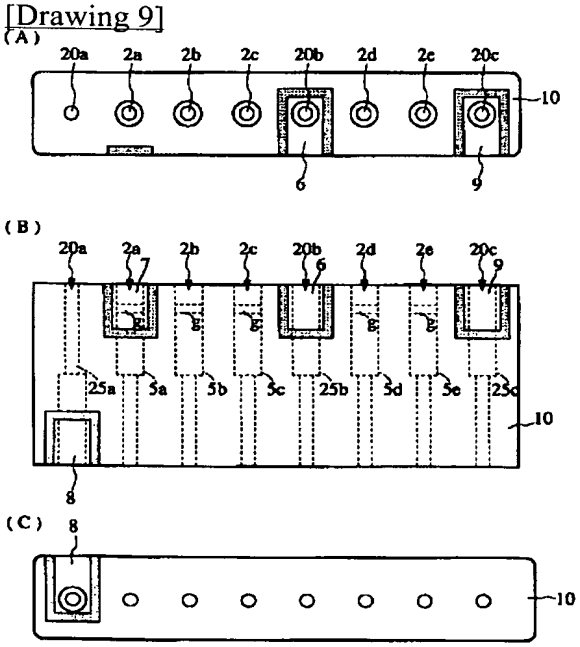
[Drawing 7]



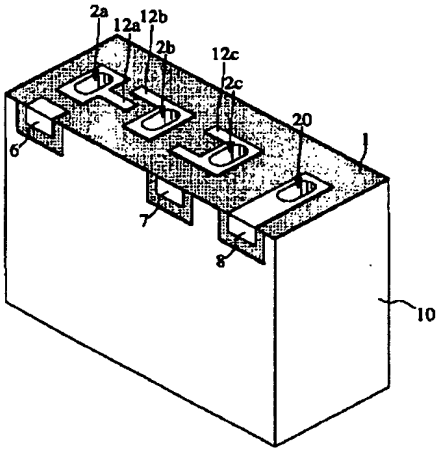
[Drawing 8]



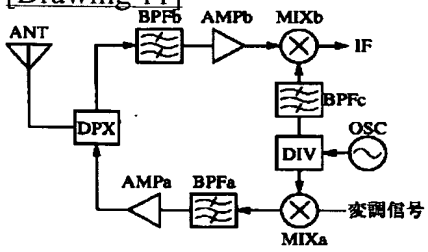
[Drawing 9]



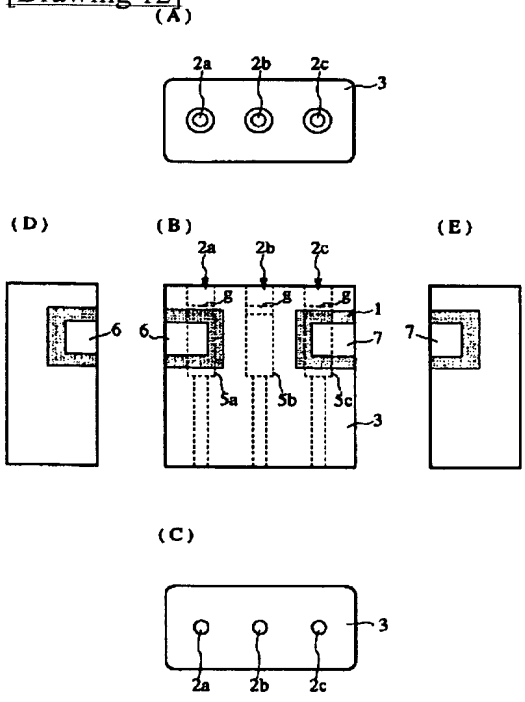
[Drawing 10]



[Drawing 11]



[Drawing 12]



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